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OCTOBER 1950

THE MGA BULLETIN

No. 21

ORGAN OF THE MUSHROOM GROWERS' ASSOCIATION

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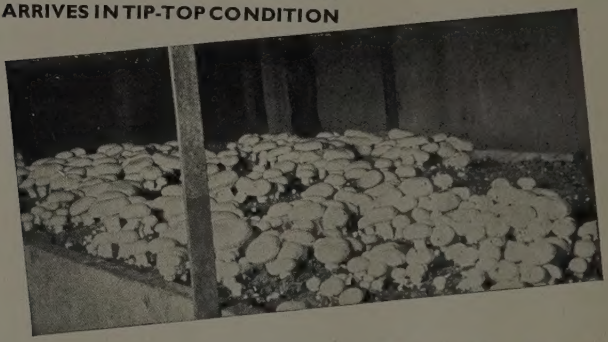

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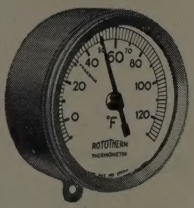

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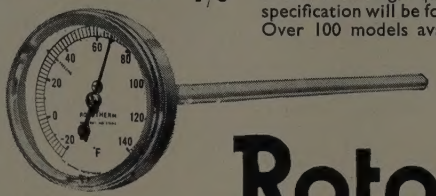

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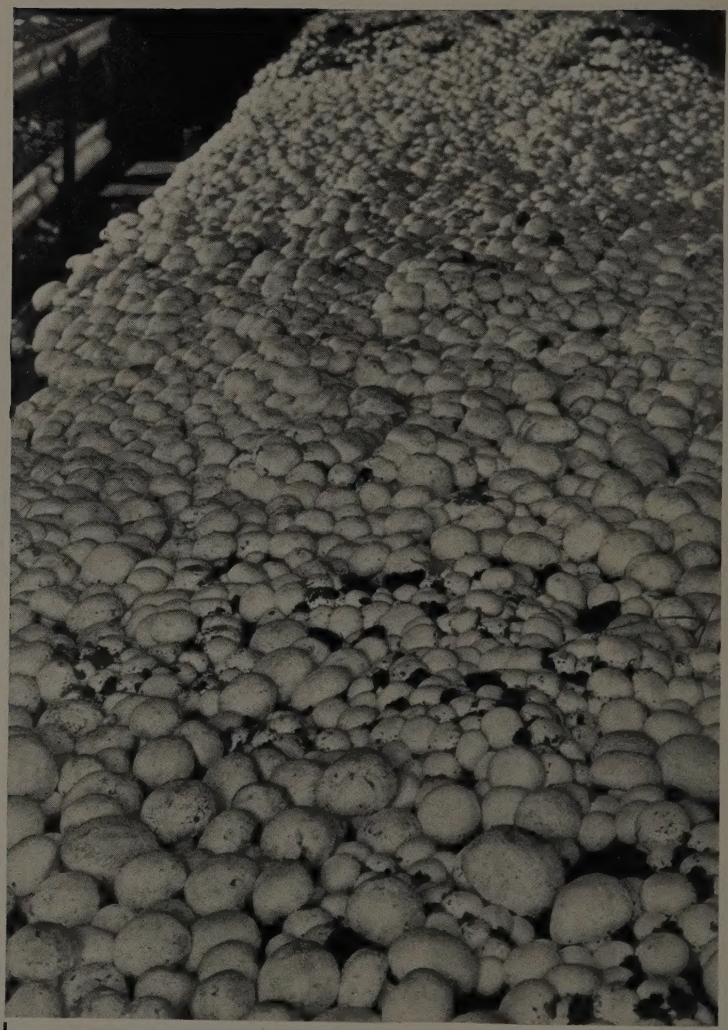

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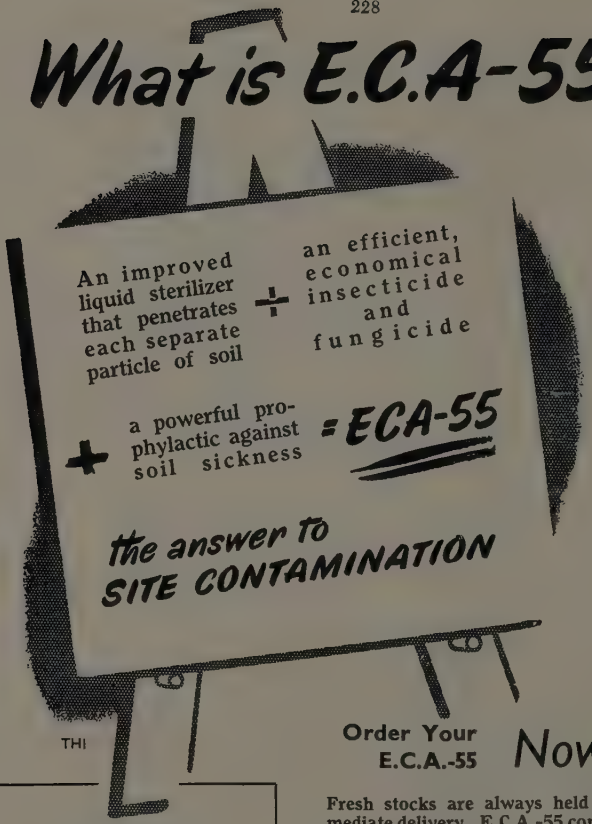
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THE

OCTOBER 1950

BULLETIN No. 21

No responsibility can be accepted by the Editor, the Editorial Board, or the Mushroom Growers' Association, for statements made or views expressed in this Bulletin, or for any advertisements included in this publication.

EDITORIAL

The mushroom in America was ' merely a taste ' until the Industry —the growers, the canners and the soup makers—got together in an all-out publicity drive to educate the public into the attractions of the mushroom. Now, I am told on good authority, the grower depends upon the canner and the soup maker to take at least half his crop during the year. Our canners and soup makers seem to have their own peculiar problems and no suggestion of any such ' get-together ' has yet been made, but it might well be a good idea.

Doesn't it seem rather fantastic that no effort has been made to ' sell ' our produce to the public? Admittedly the grower has a hard enough job growing his crop—it is the best way of staying in business—but it is by no means the end of the story. If we get a repeat of last June's prices we are going to have to do a lot more than simply grow mushrooms.

The Executive Committee have long been aware of this situation, and steps are being taken in conjunction with the N.F.U. Market Produce Show Society to stage an exhibit at the Ideal Home Exhibition in London next year, but growers can do a great deal of simple publicity themselves.

Have you ever tried selling mushrooms? A grower was telling me the other day that he has increased the sales in one of his local shops by arranging with the shopkeeper to display on the ' sale and return ' principle. He made a good job of it by having plenty of good quality mushrooms in a prominent position—not half a pound of tired flats in the bottom of a four pound chip which can be seen only too often. The result was that the weekly sales have increased from two or three pounds to between thirty and fifty pounds and encouraged by this success he is extending the idea.

In this particular case the grower had been a salesman for most of his life and knew what he was doing, but I know towns, and not small ones either, where six pounds of mushrooms would saturate the market in any one day.

We can do something about this, no one else will, and it is my earnest opinion that this essential side of our Industry has been neglected far too long.

MUTUAL AID

QUESTIONS & ANSWERS COLLECTED BY THE SECRETARY

Q. *Is there a good composting machine on the market which you could recommend and also a machine for breaking-up soil?*

A. Harry F. Atkins (Machine Tools) Ltd., of Old Fletton, Peterborough, manufacture both composting machines and soil-breakers.

Q. *Although my buildings are of thick stone I cannot keep up enough heat in frosty weather. I use coke braziers during peak heating; would it be safe to use them during cropping?*

A. Mushrooms are quickly affected by fumes and it sounds like a dangerous practice. (Have any other members tried this method?—*Editor*).

Q. *What is the best time of the year to put down outdoor beds?*

A. The practice varies: some growers lay their beds just after Christmas so that they come into crop in the Spring. One grower advocates laying the beds down in late August so that you get a crop before the winter, and then let the beds lie dormant until the warmer weather in the Spring brings them into crop again, but a hot spell in late summer would very likely damage the spawn.

Q. *Has any member reported using "Lignacite" blocks for foundation walls with Handcraft Huts?*

A. A variety of foundations are used for supporting Handcraft Huts, including foamed slag blocks, but we have no knowledge of these blocks. Can any member help?

Q. *I know that Activator "B" should not be used in contact with galvanised buckets, but can I use galvanised sheets as bed boards?*

A. Yes. There would be no risk involved using these sheets as bedboards for a synthetic compost.

Q. *I understand that radiant heating (wrought iron pipes embedded in the concrete floor) is the ideal method of heating a mushroom house as it raises the temperature of the bottom beds and increases their productivity. Is this so?*

A. A form of radiant heating was used by the Romans in their houses, and it was brought into use in this county about 60 years ago for some public buildings. The Americans have developed it and are using it on a fairly large scale to-day, but the initial cost would discourage its use for mushroom growing in this country.

Q. *What is the correct moisture content of the compost at the time of spawning?*

A. Three growers will give you three different answers on this question, but it is generally considered you want about 66% moisture at the time of filling, and this is judged by "feel." A simple moisture tester can be obtained from Thomas Ashworth & Co. Ltd., Vulcan Works, Burnley, Lancashire, for about £20.

Mechanical Loader: A party of Surrey growers visited Church Farm Nurseries, Rustington, Sussex, in June. They were particularly interested in the Compton Hydraulic Power Loader lifting sterilized casing soil from an outdoor oven on to lorries, ready for carting to the mushroom beds.

(*Perhaps Mr. Hovell will tell us more about this useful tool?*—EDITOR.)

Additions to the Library: *Champignons*, by Dr. P. J. Bels & Dr. H. C. Bels-Koning, presented by the authors. *Eelworms (Nematodes) as Pests of Mushrooms*, by C. A. Thomas & G. H. Mitchell, presented by the authors. *La Momification*, by Dr. C. Fleury, presented by the author. L. C. C. Kreiger's *Mushroom Handbook*, presented by D. F. Cave. *On a Thermophile Species of Chaetomium*, by Dr. C. J. La Touche, presented by the author. *Bulletins* 5 & 6 (May, June-July, 1950), of the French M.G.A., presented by the French growers. *Mushroom News, Vol. III (1)*, presented by W. Darlington & Sons Ltd. *Champignon-Dyrkning*, by Wm. Christensen, presented by the author.

CORRESPONDENCE

TIME STUDY : W. A. B. HARDING writes : Would the following be of any value to growers anxious to know whether their time is well spent or wasteful ? The man-hours are averaged on a basis of a 47-hour week per 1,000 sq. ft. on an average 6,000 sq. ft. farm. On farms under 6,000 sq. ft. the man-hours would be proportionally increased—on farms above, proportionally decreased.

Operation.	*Man-hours per Week.*
Daily.	
Picking	8
Grading and Packing	4
Trashing	2
Filling-in	3
Watering	½
Cleaning-out (routine house hygiene)	½
Bed and House Inspection	1
Boilers	4
Carriage to Station	3
Recording, Office and Sale Time	5
	31
Weekly.	
Composting	10
Per Cycle.	
Soil Lifting and Sterilizing	1
Preparing House	1½
Filling	1½
Casing	½
Emptying	½
Total	46 Man-hours

TWO QUERIES : We would like to know whether you can help us with the following queries which have arisen during the last month or so ? The main problem at the moment is to be able to control **Red Geotrichum** which, during the summer months, is a regular visitor. As a general rule in our experience we would say if Red Geotrichum was present in a house the crop would be affected by between 12 and 15 per cent., which quantity, of course, is of great importance during these days of low prices. We are now cropping in a house which has been attacked with a far heavier concentration of Red Geotrichum than we have seen before. Although the mushrooms are growing, the house is well under its production level, but the quality of the mushrooms is very high indeed. We peak heat our manure to approximately 140° and the houses are sterilized by steam at 180°. It is evident, therefore, that Red Geotrichum is either produced by peak heating or it survives the high temperature. In your experience, can you tell us whether Red Geotrichum has been evident in any grower's house who does not

peak heat in the beds ? We shall be very pleased to have your observations on this disease, if any more is known since you issued Dr. Sinden's article in the July Bulletin. Actually we have already treated this Geotrichum with Oakite, but, of course, this can only be applied to the surface and will not affect the mycelium which must be in the whole compost. The answer to the problem is not so much control during cropping, but one must know the ideal conditions for producing Geotrichum and then keep well away from. . . . .The other query that has arisen is of a different nature, but nevertheless interesting. Hypothetically one *could* grow mushrooms during the winter months with an **air temperature** artificially heated to between 70 and 75°. During the summer if, by any chance, one is unfortunate enough to let the temperature go over 70° in a very short time the beds cease to crop. We realise, of course, there are differences in the humidity and atmospheric conditions, but would really like to know why. Can you tell us ?

H. F. HART.

BULLETIN IMPROVES ! : I think the Bulletin gets bigger and better every issue and is a credit to the M.G.A.

Lt.-Col. J. JONES.

MALAYAN MUSHROOMS : After reading " Mushroom Growing To-day " I am emboldened to write you of my own experiences in growing . . . . . in Malaya. Mr. Atkins hasn't mentioned Malaya in his chapter " Cultivation Overseas," and having a certain pride in achievement would like to put our pioneer effort on record. I also notice that (page 63) air-conditioning as an aid to growing is mentioned. We of course have air-conditioning as our *raison d'etre* since the ambient conditions in Singapore are 86°F and 80% relative humidity. These are remarkably constant and provide a useful datum ; the problem is refrigeration allied with ventilation to control the humidity, but always from these constant outside conditions. I had had some very amateur experience in growing mushrooms before going to Malaya in 1945 and am more than usually interested in biology. Soon after my arrival I made an abortive attempt to raise some mushrooms and was talking with an American friend of my failure to do so. He is a very practical air-conditioning engineer with no pretence to " green fingers." In three weeks, with characteristic American bustle, we had a well-insulated room with four tier beds and small air-conditioner installed. He achieved conditions of 75% relative humidity with 60°F dry bulb and three air changes per hour. The manure was obtained from the Turf Club, spawn from Darlington's, and American tobacco spawn from Toughkenamon, Pa. The beds gave an area of approximately 270 sq. ft. and over four months we obtained 350 lb . . . . . in our second attempt. Costly experience was gained before this ! The market is there because Chinese love them and import a dried variety of " black " mushrooms from Japan . . . probably the " Shiitaki." That is, briefly, our story. We are of course very much alone in the venture and " seekers after knowledge." The small " prototype plant " mentioned in the foregoing will be our Research Unit. The plans for the commercial project are well in hand.

E. J. BATTEN.

EXTRACTS FROM A MUSHROOM GROWER'S ★ DIARY ★

June 6th. Last week the Leeds and District Growers visited several mushroom farms in Worthing. I hope, Worthing, you didn't miss this glorious opportunity of improving your education!

July 8th. It is reported from Edinburgh that a shopper has come across "small transparent bags of Polish Dried Mushrooms—not at all expensive compared with fresh ones."

July 10. A most promising crop has had to be turned out prematurely because of dactylium. It did 1 lb. per sq. ft. in 14 days and 2 in 40. It seemed like going on indefinitely. This creeping paralysis of a disease is spreading to other houses of the American type with timber boards. Oddly enough there's hardly any dactylium to be seen in Handcrafts with concrete beds.

July 11. "I should think Rhubarb must have averaged out less than half last season's price with the result that many growers cleared the sheds long before pulling need have stopped and got down to the summer mushroom crop," says Bill Sandford in F.T.J. this week. If I hadn't a few good friends among the rhubarb men I might be moved to say a few words at this juncture!

July 26. Racing manure composts made recently are most surprisingly turning out to be quite as good as heavy horse composts. They are, of course, pepped up in various ways. The best result to date has been from an M.R.A. pepping—2.4 lb per sq. ft. in 9 weeks picking.

July 27. Bearing on yesterday's note, I've seen to-day an excellent crop growing on pure M.R.A. synthetic (no manure at all). One begins to feel the Research Station is justifying itself.

July 31. Low prices are turning our minds to Import Duties again. I wonder how many realise that the present duty is 8d. per lb or 10% of the price whichever is the *less*. That means at 3/- per lb the duty is 3½d. Come, Come, N.F.U., get working on this. All our costs are up and yet the duty is infinitely worse than before the war when it was 8d. against a market price of 1/3-1/6.

August 6. I pass this on from the Essex Farmers' Journal for July: "In spite of all the publicity given to the subject there are still many growers who think that the state has assumed all liability for claims made by work people for **compensation for accidents** due to their employment. This is not so. Employers are still liable for claims made against them in Common Law for accidents caused by their negligence or by the negligence of the employee's fellow workmen."

August 8. We are now using live steam for peak heating. The main reason is to combat, if possible, our invasion of eelworm. It may be remembered that the worms were mainly in the lower part of the houses and it was supposed the heat of the lower beds was never enough

to effect a kill. Live steam if played into a house long enough **fills** the house and gives an almost even temperature from top to bottom. Thus, if the average termperature is high enough there should be no more eelworm—*theoretically !*

August 10. It is with mixed feelings that I read about the Socialist scheme for Horticultural marketing being " condemned as dishonest " by the N.F.U. and others. I am no lover of the Socialists but would not say their attempt is any more dishonest than some of the treatment both grower and public receive in certain circumstances under the present arrangements.

August 11. I couldn't agree more with this extract from " Smallholder" " Mushroom growing is an industry in itself rather than a section of Market Gardening and requires great specialized knowledge . . . . . commercial growers thinking of taking up mushrooms should go into the matter with *caution and care.*"

August 12. It is being argued that one explanation of heavy supplies of mushrooms this last year or two is the almost complete control of flies by DDT and Gammexane. There seems no doubt that several farms have higher averages per sq. ft. and greater turnover than for some time and the coincidence does seem marked, but my recorded averages for 1938-1940 are quite as good as my present " improved " figures. In those days one was inevitably met by dense clouds of flies when one entered a growing shed.

August 15. My hot water boilers are off this month. I was somewhat shocked therefore to find the thermometer in one of them reading 120° this morning. The explanation ? We were steaming a house and the live steam had evidently heated the flow pipes to this temperature. This heated water had backed to the boiler and become trapped there because the circulating pump was switched off.

August 18. It is said that field mushrooms are much scarcer than they used to be. Two reasons are given : increased use of artificials and decreasing number of horses. Yet last year our Northern markets were swamped by lorry loads of the things.

August 20. The early morning statisticians are busy again. The following mushrooms are being tabulated : (a) 46 ins. circumference weighing 2 lb 9 ozs. (Norfolk) ; (b) 15 ins. in diameter (Essex) ; (c) over 8 ins. in diameter (Manchester garden) ; (d) over $2\frac{3}{4}$ lb, 14 ins. diameter (East Anglia).

August 26. Having a lot of trouble with mat disease (some form of *Myceliophthora*). It attacks the top of the compost immediately below the casing and may or may not be responsible for the fact that for eighteen months we have not been able to exceed 2.5 lb per sq. ft. On the other hand there is no proof that it does not appear simply because (or when) the spawn is exhausted—it may not be a competitor while spawn is lively. It is light brown in colour—cork colour, someone described it—with a musty dead-seaweed sort of smell. I've shown it to a Worthing grower who told me he'd had it badly but was gradually eliminating it by peak heating. It may be the steam heating which I'm using against eelworm will work a miracle here too. But where

does this "mat" come from? Soil? Compost? Contaminated composting floor?

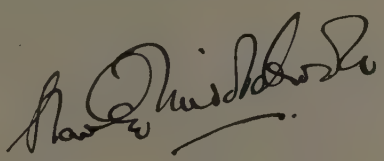
August 27. I've now covered several practice laps with trays (Yes, I was at Silverstone yesterday!) and am gradually drawing the conclusion that there may be little or no advantage in the method when taken over a year. At all events on anything but the largest possible mechanised scale. It's a long story, but it can be worked out on paper when you've provided yourself with some facts from practical growing. Prior to practical tests the "facts" were guesswork. I had hoped to turn over about 8 houses to trays but I'm not at all convinced that it would not be a serious mistake. For some time I shall stick to one experimental house. Moreover news filters through in driblets that others have similar doubts. A consistently high level of cropping must be maintained if the extra expenses, overheads, labour, etc., are to be met.

August 28. There is a welcome and necessary tendency towards slightly higher prices. Frankly we could not tolerate those low early August prices for long. As it is, I fancy many a small new grower must have been wondering how the crazy idea got into his head that there was a fortune in mushrooms. However, compared with the catastrophic slump in the demand and price for most vegetables, mushroom growers are perhaps fortunate in that they have *some* return.

August 31. A Harrogate retailer (400 lb a week) tells me his public prefer flats to cups or buttons. Flats, he says, are more like field mushrooms and are often assumed by buyers to *be* so. He often advises customers to leave the flats a few days till the gills go black to assist the illusion. Is this why one sometimes sees flats quoted as high and occasionally higher than buttons in Covent Garden?

September 1. Is it true that £7,000 worth of mushrooms were imported from Eire in June alone?

September 2. It is common knowledge that whenever one has a visitor there are no mushrooms to be seen. "If only you'd been here yesterday . ." Try it the other way round. If you've no mushrooms, expect a visitor. You'll be surprised how often it works.



A.G.M.—The Fifth Annual Lunch and Meeting of the M.G.A. is being held on Wednesday, 4th October, at the Connaught Rooms, Great Queen Street, London, W.C.2. A full report will appear in our January issue.

THE RESEARCH FUND

The prospect is brighter than it seemed three months ago, but is still formidable. A most encouraging and generous gesture was made by J. Beveridge & Co., of Kinross; Mr. John Beveridge wrote to Yaxley: *"We are grieved to see that you still require £900. We increase our subscription to £50 (Cheque for £30 enclosed). We do hope and trust other growers will give more financial support for such excellent experiment and research work as you are certainly doing. Great credit is due to all in research."*

The following list of contributors is complete up to August 15th. Particularly appreciated are cheques from Australia, Switzerland, and South Africa.

	£	s.	d.
C/f. from Bulletin 20 ...	1,521	2	0
Beveridge, J. Ltd. ... (2nd sub. this year)	30	0	0
British Basket & Besto Ltd.	20	0	0
Sinfield, C. L.	20	0	0
Mas, R. (Australia) ...	*12	10	0
Boots Pure Drug Stores	10	0	0
Collingridge, J. Ltd. ...	10	0	0
Bateman, F. W. (Furber Nurseries Ltd.) ...	5	5	0
Lamsdale, G. (Kingfisher Mushroom Co. Ltd.)	5	5	0
Ball and Luxmoore ...	5	0	0
Bell, Lt. Col. H. G. ... (2nd sub. this year)	5	0	0
Collins, Gordon ...	5	0	0
Fell, H. H.	5	0	0
Knight, W. & Sons (Westham) Ltd.	5	0	0
Kuhn, J. (Switzerland)	5	0	0
Meade, R.	5	0	0
Randall, W. B. Ltd. ...	5	0	0
Speller, R. L. & R. ...	5	0	0
Fitzpatrick, P. & T. Ltd.	3	3	0
Griffiths, G. (Wrington Vale Nurseries) ...	3	3	0
Kessler, J. L.	3	3	0
Turner, Col. W. A. (2nd sub. this year) ...	2	10	0
Briggs, C. C.	2	2	0
Godfroy-Harris, Mrs. (S.A.)	2	2	0
Robotham, A. (Australia)	2	2	0
How, W. L.	2	0	0
Watts, J.		5	0
	1,699	12	0
* *Less £2 12s. 10d.* currency rate ...	2	12	10
	£1,696	19	2

Dr. R. L. EDWARDS reports to the Mushroom Industry:

Developing a Synthetic Compost

3. TRACE ELEMENTS AND POTASSIUM

Two earlier articles under this heading have described some of the experiments carried out during the search for a satisfactory Synthetic Compost based on wheat straw. In this section the effect of mixtures of trace elements and of different quantities of potassium sulphate are described.

It has been known for many years that a dozen or so elements were necessary, in extremely small quantities, for normal plant and animal life; these have become known as trace elements. They are usually present in soil and are absorbed from the soil by growing plants which pass them on to other forms of life. There are a few soils which are abnormal in lacking one or more of these elements, and in those cases plant or animal deficiency diseases may occur. Attention was drawn to these trace elements in connection with mushroom growing by Stoller who proposed the use of a mixture supplying ten of them, based on

analyses of mushrooms and of horse manure. Treschow also used some of them in his experiments on the growth of mushroom mycelium in pure culture. Two mixtures (Table 1) based on their work were used in experiments which gave the results summarised in Table 2. There is no doubt about the beneficial effect of mixture "S" which obviously supplied something lacking in the untreated control composts. Mixture "T" had the interesting effects of stimulating early fruiting but reducing the total yield. This mixture contained a very high proportion of magnesium which was absent from mixture "S," and it seems likely that the magnesium was responsible for the harmful effect. We have found in another experiment, where the magnesium content of a series of composts varied rather irregularly, that the high magnesium composts tended to give lower yields. Dr. Hauser has also found that high magnesium in casing soil was toxic.

No experiments have yet been possible on the separate elements in Mixture "S" to determine which of them are responsible for the effects on cropping and whether any of them can be omitted. For the present it is safest, and not too expensive, to use the whole mixture until such time as more experiments can be carried out. It is, of course, possible that varying the proportions and total quantity of this salt mixture might still further improve the yield, but many experiments would be needed to exhaust the possibilities in this direction.

Effect of Potassium

Potassium is an essential nutrient for all forms of plant life, including the mushroom. It is present in considerable amounts in straw. Synthetic composts made up in Britain, France and America have included quantities varying from none up to 75 lb. of potassium sulphate per ton of straw. We tested three quantities in and beyond this range, as shown in Table 3, which also gives the results obtained. It is clear that the quantity of potassium had no effect on cropping time, but the smallest quantity gave the best yield. The same quantities of potassium sulphate were also added to a series of composts containing nitrochalk in place of dried blood, and in this case the highest quantity of potassium sulphate gave the best yield, but all yields were so low that the result, though interesting, was of no practical importance. All yields in this experiment were low because of other unfavourable factors which affected all the experimental composts equally.

Table 1. Mixtures of trace elements used per ton of straw

	S.		T.	
	lb.	oz.	lb.	oz.
Manganese sulphate	5	10		$\frac{1}{6}$
Iron (ferrous) sulphate	2	13		$\frac{1}{6}$
Aluminium sulphate		10		
Copper sulphate		10		$\frac{1}{6}$
Zinc sulphate		5		$\frac{1}{6}$
Basic chromium sulphate		$2\frac{1}{2}$		
Boric acid		5		
Potassium bromide		$1\frac{1}{4}$		
Potassium iodide		$\frac{1}{8}$		
Magnesium sulphate			4	6

Table 2. Effect of mixtures of trace elements

	None	Salt Mixture S.	T.
Interval from spawning to fruiting	62	39	46 days
Mushrooms per sq. ft. in 12 weeks picking	17	17	8
Average size oz./mushroom	0·7	0·9	0·8
Yield lb./sq. ft. in 12 weeks picking	0·7	1·0	0·4

Table 3. Effect of varying potassium in dried blood composts

	K^1	K^2	K^3
Potassium sulphate added per ton of straw	14	63	112 lb.
Interval from spawning to picking	94	102	96 days
Mushrooms per sq. ft. in 12 weeks	18	13	6
Average size oz./mushroom	0·7	0·7	0·8
Yield, oz./sq. ft.	13	9	5

Recommended Mushroom Grades

Grades for cultivated mushrooms were discussed at a meeting in London, on 16th May, called by the Root, Stem and Stalk Vegetables Marketing Sub-Committee of the Ministry of Agriculture. All sections of the Trade were represented, Mr. H. G. Boxall being the spokesman for the M.G.A.

The Committee considered documents on the pre-war grades for mushrooms, on the standard grades proposed by the M.G.A., on the West Sussex grades for mushrooms, and various other documents and memoranda submitted by Ministerial departments.

NUMBER OF GRADES

The committee had before them the M.G.A.'s grades and grade definitions. Mr. Pearson of the Horticulture division of the Ministry of Agriculture considered that the pre-war statutory grades were too numerous and complicated for practical use by mushroom growers generally. He suggested that the grades put forward by the M.G.A. would better meet present day requirements. Mr. Hall, of the Department of Agriculture for Scotland, agreed. Mr. Foster, of Broome and Green, drew attention to the West Sussex Growers' grades which are widely used in that area.

SIZE

Mr. Foster said that in West Sussex the grades used compared very closely with the pre-war statutory grades except that the 'Open' grade diameter went up to $4\frac{1}{2}$".

Mr. Boxall explained the sizes put forward by the M.G.A., namely one general size for buttons, cups and opens ranging from 1" to $2\frac{1}{2}$" with permitted deviations from this size to provide for local needs. Mr. Pearson said that he would favour the adoption of the size range suggested by the M.G.A. but that he would like to see the maximum size fixed for large opens. In his view $4\frac{1}{2}$" was too large and he would prefer to see the maximum placed at $3\frac{1}{2}$". This was agreed by the committee. Mr. Hawkins of the Fruit Retail Trades Federation said that some reference should be made to the length of stem as it was his experience that the housewife did not favour too long a stem. Mr. Monk of the C.W.S. was in favour of keeping the stalk as short as possible.

Mr. Priest of Birmingham, agreed that damage and bruising was often caused by stems left too long and in his opinion the maximum length of 1" suggested by the M.G.A. was appropriate.

Mr. Boxall asked the reason for the prejudice against the stem when it was as edible as the rest of a mushroom. Mr. Hawkins said it could not be explained except as housewife's prejudice.

After further discussion the committee agreed that the length of stem (to the butt from the point at which the membrane covering the gills joins the stem) for the Cups and Open grades should not be more than 1" in length, and for the Buttons grade not more than $\frac{3}{4}$" in length.

The chairman, Mr. J. H. Gorvin, said that the concordance between the views of the committee and the M.G.A. should ensure a wide adoption for the use of the 'Recommended' grades. Agreement on revised grade definitions was proof of the wisdom of not regarding the statutory grades as static, but continuously subject to change to meet new conditions and the aspirations of new organisations of growers.

STANDARD CONTAINERS

Mr. Barnard, of Waltons, said that his company had experimented with small consumer packs holding 4 ozs. of mushrooms and it had met with some success. Mr. Williams of the Ministry of Food thought that it was too early to make any firm recommendations on the pre-packaging of mushrooms; more experimental work was still needed. Mr. Maltby of the Ministry of Food said that the 4 lb. might prove to be the popular size with the retail trade with perhaps the $2\frac{1}{2}$ lb. container as the next popular size. Mr. Boxall said that a $2\frac{1}{2}$ lb. veneer chip was very popular in West Sussex and with the large Covent Garden Salesmen.

The committee agreed that the containers below should be adopted as standard containers :

No. 12 Taper chip (670 cu. ins.)
No. 4 Standard Mushroom basket (430 cu. ins.)
No. 6 Taper Chip (370 cu. ins.)
No. 2 Chip (150 cu. ins.)

LABELLING AND PACKING

Mr. Hawkins said that he strongly favoured the declaration of net weight of mushrooms at the time of packing. This would act as a check on the packer and an assurance to the retailer. On numerous occasions containers arriving at the retail shops were found to be several ounces short and with a comparatively expensive commodity such as mushrooms the retailer would be helped by declaration of net weight at time of packing. Mr. Foster said that he had recommended Sussex packers to give good weight in order to allow for evaporation. Good growers and packers in fact made this provision. Mr. Boxall said that most growers put about 2 oz. overweight in each container to offset loss in transit. The proposed methods of labelling and packing were agreed subject to suggestions made through Mr. Boxall by the Mushroom Growers' Association.

The Committee agreed that in the drafting of the Advice paragraphs for the Marketing leaflet the M.G.A. should be asked to co-operate.

The following are the 'Recommended Grades':

SELECTED BUTTONS R

Membrane securely intact and likely to remain unbroken for 24 hours.
Minimum diameter of cap 1", maximum 2½".
Length of stem when trimmed shall not exceed ¾".

SELECTED CUPS R

Membrane breaking or broken. The mushroom is in an open stage of maturity, the cap retaining a pronounced downward curve. Minimum diameter of cap 1", maximum 2½".
Length of stem shall not exceed 1".

SELECTED OPENS R

Mushrooms advanced beyond the Cup stage, the cap forming a letter 'T' with the stalk.
Minimum diameter of cap 1", maximum 2½".
Length of stem when trimmed shall not exceed 1".

GENERAL

The mushrooms in any one container shall be fairly uniform in size, have similar varietal characteristics, be of similar colour, and free from dirt, disease, insect damage, malformation, pronounced discolouration or other serious blemish.

French Mushroom Research Station

The February Bulletin of the French National Federation of Mushroom Growers includes an article by the President, M. Guiochon, describing the Federation's plans for research. A library is already being established and mushroom literature from all over the world is being examined.

A small research station is being set up in a well-ventilated cave near Paris, to include a pasteurisation room for compost, a room for spawn running, and a cropping room. The pasteurising room will be heated by steam, giving control over humidity and temperature up to 140°F.

The spawn running room will be electrically heated and thermostatically controlled.

Experiments will be made first in trays, for economy in labour and materials, and if promising they will be repeated in the traditional French floor beds.

The programme includes studies on the effect of pasteurisation, various additions to compost, degrees of fermentation, and growing conditions.

Analyses will be made by the Agricultural Research Station at Versailles.

The research station will be controlled by a Technical Committee of the Federation, with the advice of M. Boischot, Director of the Versailles Research Station, and its first Director will be M. de Zalay.

All results obtained will be published in the Bulletin of the Federation (which is sent to the M.G.A. regularly).

Edmund B. Lambert and Harry Humfeld on .....

MUSHROOM CASING SOIL IN RELATION TO YIELD

In view of the revival of interest in casing soils, the M.G.A. Bulletin has been reproducing the most important scientific contributions to this problem. The series would not be complete without Dr. Lambert and Dr. Humfeld's paper, which is here reprinted with acknowledgments from Circular No. 509 of the United States Department of Agriculture, Washington, D.C., May, 1939.

Introduction : Since the beginning of mushroom culture, growers have found it necessary to spread a shallow layer of soil over the beds in order to induce the mycelium in the beds to produce mushrooms. This layer is usually referred to as the casing soil. De Tournefort (11)* as early as 1707 described the use of casing soil in mushroom culture in France. In 1882 Lachaume (4) gave an account of casing procedure used in the underground quarries of France. This procedure was essentially that practiced in France to-day ; powdered rock was screened from the debris that accumulated near the face of the stone quarries in which mushrooms were grown and was mixed with soil in the proportion of three parts of rock powder to one part of soil. The beds were covered with this mixture to a depth of about three-fourths of an inch as soon as the mycelium showed signs of running through the compost.

According to Robinson (9) and Falconer (2), the market gardeners who raised mushrooms in England and the United States prior to 1890 preferred a rich garden loam, which they placed on the beds, from 4 to 10 days after spawning, in a layer 2 to 3 inches deep. Most growers pounded down the soil to a hard surface. By 1915 Duggar (1) and Jackson (3) pointed out that the customary deep casing soil was giving way to the thinner casing adopted by the French 30 years earlier. The need for a very rich loam and firming the soil was also doubted by many growers.

At the present time growers prefer a depth of casing of from three-fourths to 1¼ inches. They also agree rather generally that the proper time to case is from 1 to 3 weeks after the mycelium has begun to run in the beds. With regard to the texture of the soil, however, different customs have gained favour in France, England, and the United States. The French still prefer the quarry debris, le bousin, which for them is probably more accessible and free from Mycogone disease than the soil. Ware (12) points out that the English in order to avoid Mycogone have come to use soil from at least 6 inches depth rather than the surface soil, which is still generally used in the United States. Both heavy clays and sandy soils are usually avoided.

In Germany, Passecker (7) recommends the use of a sandy loam soil applied to a depth of an inch after the spawn has run from 10 days to 2 weeks. He also suggests that only the lower layers of soil be used, in order to avoid diseases resulting from contamination of the surface soil.

* Numbers in parentheses refer to Literature Cited, p. 251.

In the United States the practice of liming casing soil has evolved in the last 15 years. In England the custom mentioned by Ware (12) of mixing one half of a bushel of lime with each cubic yard of soil is probably much older. Recent recommendations (6, 8, 10, 12), specifying minimum, optimum, and maximum pH values are largely based on a knowledge of the comparative-yield tests described in this circular.

As far as the writers are aware no replicated yield tests have been previously recorded as a basis for casing-soil practice. In general the criteria for selecting the casing soil and the methods used in applying it are based largely on custom presumably derived from numerous informal empirical tests. The material presented here is the result of replicated field tests made to learn something of the desirability of continuing or modifying certain of these practices.

Experimental Methods : The yield tests were in all cases conducted at Arlington Experiment Farm, Arlington, Va., and were made on plots 2 by 5 feet handled uniformly according to standard practice except for the treatment under consideration. In all tests except those recorded in table 2 the plots were laid out in randomized blocks, using entire beds as replicate blocks as suggested in an earlier paper (5). Most of the tests were replicated five times. In the experiments recorded in tables 5 and 6, the yield was interfered with on one of the beds (blocks) by some factor entirely irrelevant to the experiment, and because of this an entire block was discarded, leaving only four replications. The yields recorded are the sums of about 30 pickings for each crop. As a rule the mushrooms were picked every 2 or 3 days and the beds continued bearing about 3 months. The recorded weights include the weight of the stems in all experiments made subsequent to 1932. Except where otherwise indicated the standard errors of the experiments were calculated by the analysis of variance method. The standard errors of the treatment means are attached to the tables as footnotes wherever the variance due to the treatments was distinctly greater than variance due to random error.

Thickness of Casing Soil : To test the relation of the thickness of casing soil to yield, an experiment was made in which plots were cased to different depths but otherwise were treated as nearly alike as possible. The mean yields per square foot from the 15 plots were as follows : Beds cased 1 inch yielded 1.6 pounds, beds cased 1½ inches yielded 1.5 pounds, and beds cased 2 inches yielded 1.6 pounds. In a subsequent experiment 12 plots were cased 1 inch deep, and 12 comparable plots were cased 2 inches. The mean yields of these two series were nearly identical, the former being 2.18 pounds per square foot whereas the latter was 2.15 pounds.

It was quite clear that moderate differences in thickness of casing did not influence yield. The results of these experiments, therefore, are in accordance with the present practice of using approximately 1 inch of casing, as opposed to the older practice of casing 2 or 3 inches thick. The 1-inch depth is preferable to a thicker layer, because it is more economical to apply and because mushrooms appear sooner on 1-inch casing than on thicker casing. When casing is applied to a depth of less than 1 inch, it is difficult to spread the soil evenly and to maintain

a proper moisture content. Furthermore, with shallow casing there is a greater chance of injuring the mycelium in the compost immediately beneath the casing by overwatering. This oftentimes is the cause of a seriously reduced yield.

Time of Casing : Two experiments were made in which the time of casing was the factor considered. The results of these experiments are summarized in tables 1 and 2. These data indicate that both early casing and late casing may sometimes reduce the total yields. When interpreting the results given in table 2 it should be kept in mind that the plots numbered differently were in many cases subjected to different conditions. Therefore, the only variability relevant to the problem lies in differences between the yields of paired plots cased at different times, such as 1 and 1a, 2 and 2a, etc. This was taken into consideration when calculating the odds given at the foot of the table by using the pairing method for calculating the standard error of the means of the differences.

TABLE 1.—*Relation of time of applying casing soil to yield of cultivated mushrooms.*

(Tests made in 1931)

Time of casing	Bed No.	Yield per 10 square feet	Mean yield per square foot*
		Ounces	*Pounds*
Filling time	1	166	1.2
	2	139	
	3	180	
	4	187	
	5	218	
Spawning time	1	182	1.2
	2	152	
	3	219	
	4	205	
	5	213	
2 weeks after spawning	1	257	1.6
	2	242	
	3	275	
	4	238	
	5	288	

*Standard error of the mean yield of 5 plots is 0.08 pound per square foot.

TABLE 2.—*Comparison of mushroom yields from beds cased 2 and 4 weeks after spawning.*

(Tests made in 1931)

Plot No.	Yield per 10 square feet		Plot No.	Yield per 10 square feet		Plot No.	Yield per 10 square feet	
	Cased 2 weeks after spawning	Cased 4 weeks after spawning		Cased 2 weeks after spawning	Cased 4 weeks after spawning		Cased 2 weeks after spawning	Cased 4 weeks after spawning
	Ounces	*Ounces*		*Ounces*	*Ounces*		*Ounces*	*Ounces*
1 and 1a	288	274	7 and 7a	304	230	13 and 13a	252	237
2 and 2a	257	189	8 and 8a	227	247	14 and 14a	383	275
3 and 3a	261	259	9 and 9a	246	215	15 and 15a	300	259
4 and 4a	238	168	10 and 10a	202	88			
5 and 5a	139	141	11 and 11a	382	212	Mean yield*	273.4	214.4
6 and 6a	343	223	12 and 12a	279	200			

*The standard error of the mean of the differences is 13.9 ounces per 10 square feet.

Here again, when considered as a whole, the results of the yield tests were in agreement with general commercial practice. With a

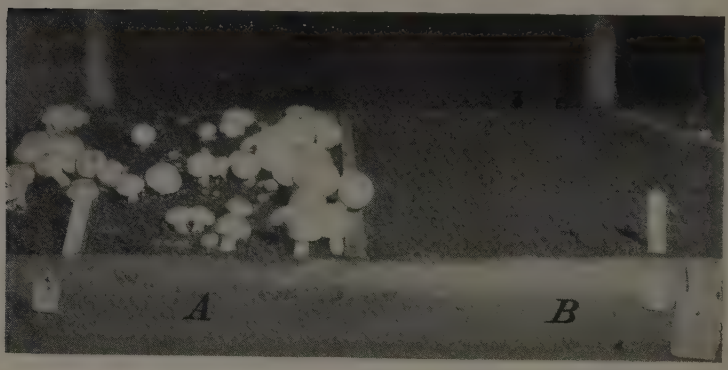


FIGURE 1.—Effect of the reaction of the casing soil on the yield of cultivated mushrooms : (*a*) neutralized soil, (*b*) acid soil.

normal run of mycelium in the beds the best yields were obtained when the casing was applied 2 or 3 weeks after spawning. At this time the mycelium had usually appeared on the surface of the beds in patches 6 inches in diameter. Earlier or later casing reduced the yields in certain of the experiments.

Reaction of the Soil : In the first experiment planned to test the effect of the reaction of the soil on yields, a soil series was made with four different pH values. This series was made from a Keyport clay loam with a natural reaction of pH 6.0. The hydrogen-ion concentration was increased with sulphuric acid and decreased with hydrated lime. It is evident from the yield data in table 3 that production was sharply reduced when sufficient acid was added to the soil to increase the hydrogen-ion concentration to pH 4.4. There was some doubt, however, whether the reduced yield was due to an excess of sulphur or to hydrogen-ions in the acidified soil.

To answer this question a naturally acid soil was used to make up a series of soils of different pH values. When beds were cased with these soils the yields shown in table 4 and figure 1 were obtained. The poor yield from the acid soil and the beneficial effects of liming are clearly indicated.

TABLE 3.—*Effect on the yield of cultivated mushrooms of treating casing soil with sulphuric acid and with hydrated lime.*

(Tests made in 1931)

Material added per pound of soil and reaction of soil before casing	Bed No.	Reaction Mar. 17	Reaction May 15	Yield per 10 square feet	Mean yield per square foot*
		pH	*pH*	*Ounces*	*Pounds*
20 cc N/1—sulphuric acid, pH 4.4	1	....	5.8	88	0.9
	2	....	4.9	202	
	3	4.7	4.8	141	
	4	4.3	5.4	139	
	5	4.8	5.2	143	
8 cc N/1—sulphuric acid, pH 5.2	1	....	5.7	215	1.3
	2	....	5.4	246	
	3	5.3	5.5	168	
	4	5.4	5.7	238	
	5	5.1	5.4	208	
Untreated, pH 6.0	1	....	5.6	247	1.5
	2	....	5.7	227	
	3	6.1	6.2	259	
	4	5.8	6.0	261	
	5	5.9	6.1	236	
½ g hydrated lime, pH 7.2	1	....	7.0	230	1.5
	2	....	7.0	300	
	3	7.0	6.9	189	
	4	6.9	7.0	257	
	5	6.8	6.9	207	
1½ g hydrated lime, pH 7.9	1	....	8.1	223	1.7
	2	....	7.9	343	
	3	7.8	8.0	274	
	4	7.8	7.9	288	
	5	7.8	7.8	269	

*Standard error of the mean yield of 5 plots is 0.09 pound per square foot.

TABLE 4.—*Effect on the yield of cultivated mushrooms of adding hydrated lime to an acid casing soil.*

(Tests made in 1932)

Hydrated lime added	Reaction at time of casing	Bed No.	Yield per 10 square feet	Mean yield per square foot*
	pH value		*Ounces*	*Pounds*
0.0 per cent.	4.8	1	0	0.2
		2	67	
		3	63	
		4	26	
		5	7	
0.2 per cent.	6.7	1	245	1.4
		2	301	
		3	189	
		4	128	
		5	226	
0.4 per cent.	8.1	1	171	1.3
		2	187	
		3	254	
		4	216	
		5	194	

*Standard error of the mean yield of 5 plots is 0.12 pound per square foot.

TABLE 5.—*Effect on the yield of cultivated mushrooms of adding excessive amounts of hydrated lime to the casing soil.*

(Tests made in 1933)

Hydrated lime added	Bed No.	Reaction at— Time of spawning	Reaction at— End of crop	Yield per 10 square feet	Mean yield per square foot*
				Ounces	*Pounds*
0 per cent	1	*pH* 6.9	*pH* 6.9	234	1.6
	2			237	
	3			241	
	4			311	
0.1 per cent....	1	7.6	7.7	287	1.7
	2			261	
	3			287	
	4			261	
1 per cent....	1	8.5	8.3	239	1.6
	2			242	
	4			204	
	5			312	
2 per cent.	1	†8.6	†8.6	219	1.2
	2			159	
	3			149	
	5			230	
4 per cent.....	1	†8.7	†8.7	119	0.8
	3			142	
	4			123	
	5			109	

*Standard error of the mean yield of 4 plots is 0.20 pound per square foot.
†The actual pH value is no doubt higher than the values shown because of the limitations of the quinhydrone method when applied to material having a pH value above 8.3.

Another series was made up to determine the effect of an excess of hydrated lime (calcium hydroxide) in the casing soil. As shown in table 5 there was a distinct tendency toward a reduction of yield as a result of excessive liming with this material.

The following fall a similar experiment was set up, using high-calcium limestone in place of hydrated lime. In this experiment five times more limestone was used than was necessary, yet there was no statistically significant reduction in yield, as shown in table 6.

TABLE 6.—*Effect on the yield of cultivated mushrooms of adding excessive amounts of limestone to the casing soil.*

(Tests made in winter of 1933-34)

Limestone added	Bed No.	Yield per 10 square feet	Mean yield per square foot	Limestone added	Bed No.	Yield per 10 square feet	Mean yield per square foot
		Ounces	*Pounds*			*Ounces*	*Pounds*
0 per cent.	1	263	1.4	12 per cent.	1	228	1.4
	2	214			2	246	
	3	273			3	207	
	4	122			4	201	
6 per cent. . .	1	244	1.4	25 per cent.	1	205	1.2
	2	285			2	215	
	3	180			3	152	
	4	196			4	179	

The tests as a whole clearly indicated that soil approximately neutral in reaction yielded better than acid soil or excessively alkaline soil. Any pH value between pH 5.5 and pH 8.0 seemed suitable. It is evident that hydrated lime may be injurious if added to the soil in excess. On the other hand, limestone (more than 90 per cent. calcium

carbonate) was found to be just as effective in neutralizing the soil as hydrated lime, and there seemed to be practically no danger of injuring the crop from adding an excess.†

At the present time many growers neutralize the soil with hydrated lime, and after the crop comes into bearing some of them fill the holes on the bed with a mixture of one-tenth hydrated lime to nine-tenths soil. They also water the beds occasionally with limewater. In the opinion of the writers it is just as effective, and safer practice, to add from 2 to 5 per cent. of limestone (high in calcium carbonate) to the original casing soil and to the soil used for filling holes in the bed. The custom of using hydrated lime instead of limestone seems to be based on an erroneous opinion which is prevalent among growers, that limestone must be added to casing soil several months before using. In the experience of the writers, powdered limestone neutralized the soil sufficiently for practical purposes overnight. Thus the slower action of the limestone is more of a theoretical objection than a practical one. Furthermore, an excess of limestone may be safely added, and the continued buffering effect of the residual limestone is beneficial in that it neutralizes the organic acid produced by the mushroom mycelium.

Texture of Soil : In the initial experiment to determine the effect of the texture of the soil on yield, soils of four different textures were used : Clay loam, loam, sandy loam, and sand. Each soil was limed to approximate neutrality. As apparent from table 7, there was an unmistakable tendency for the heavier textured soils to support better yields of mushrooms than the light soils. The clay loam yielded twice as much as the sand.

TABLE 7.—*Relation of the texture of casing soil to the yield of cultivated mushrooms.*

(Tests made in winter of 1934-35)

Texture and source of soil	Bed No.	Yield per 10 square feet	Mean yield per square foot*
		Ounces	*Pounds*
Keyport clay loam, Arlington, Va.	1	356	2.0
	2	208	
	3	344	
	4	326	
	5	401	
Keyport loam, Beltsville, Md.	1	303	2.0
	2	331	
	3	357	
	4	268	
Sandy loam, Arlington, Va.	1	206	1.5
	2	229	
	3	250	
	4	260	
	5	254	
Sand, Arlington, Va.	1	142	1.0
	2	267	
	3	214	
	4	114	
	5	109	

*Standard error of the mean yield of 5 plots is 0.09 pound per square foot.

†This statement refers only to limestone high in calcium carbonate. Both hydrated lime and limestone are frequently high in magnesium. The effect of an excess of magnesium in the soil has not been systematically investigated, but it has the reputation among commercial growers of being harmful.

TABLE 8.—*Relation of texture of casing soil to yield of cultivated mushrooms*

(Tests made in winter of 1935-36)

Texture and source of soil	Limestone added	Reaction at casing time	Bed No.	Yield per 10 square feet	Mean yield per square foot*
	Per cent.	*pH*		*Ounces*	*Pounds*
Hyperhumus, New Jersey	1½	6.1	1	434	2.6
			2	476	
			3	488	
			4	395	
			5	330	
⅔ Keport clay loam, Arlington, Va.+ ⅓ hyperhumus, New Jersey	2½	6.8	1	519	2.5
			2	291	
			3	412	
			4	483	
			5	302	
Houston clay, Texas (high in limestone and organic matter; black soil)	0	8.2	1	335	2.4
			2	325	
			3	349	
			4	549	
			5	352	
Keyport clay loam, Arlington, Va.	2½	7.4	1	553	2.8
			2	285	
			3	435	
			4	487	
			5	419	
Do.	2½	7.4	1	451	2.3
			2	336	
			3	365	
			4	448	
			5	245	
Do.	2½	7.4	1	413	2.1
			2	467	
			3	[illegible]	
			4	278	
			5	382	
Keyport clay loam, Arlington, Va.	2½	7.4	1	350	2.3
			2	359	
			3	419	
			4	311	
			5	381	
Chester loam (heavy texture), near Kelton, Pa.	½	6.3	1	427	2.1
			2	326	
			3	235	
			4	352	
			5	360	
Chester loam (light texture), near New Garden, Pa.	½	6.2	1	419	1.8
			2	225	
			3	294	
			4	236	
			5	301	
Manor loam, near West Chester, Pa.	0	7.2	1	429	1.9
			2	218	
			3	363	
			4	257	
			5	260	
Carrington loam, Ames, Iowa	0	7.2	1	293	1.8
			2	299	
			3	306	
			4	350	
			5	239	
Brandywine loam, near Embreeville, Pa.	0	5.8	1	372	1.7
			2	409	
			3	267	
			4	116	
			5	230	
Sandy loam, Arlington, Va.	2½	7.7	1	353	1.7
			2	250	
			3	328	
			4	215	
			5	239	
Sand, Arlington, Va.	2½	7.8	1	370	1.7
			2	318	
			3	243	
			4	126	
			5	346	

*Standard error of the mean is 0.15 pound per square foot.

A more extensive series of soils was compared in a later test which is summarized in table 8. In this experiment there again seemed to be a significant tendency for the heavier soils to yield better than the sandy soils. A comparatively high yield was obtained from neutralized hyperhumus, but the mushrooms from the beds cased with this material were inferior in quality because of excessive spotting. Differences in earliness as well as in yield as a result of soil texture are strikingly illustrated in figure 2.

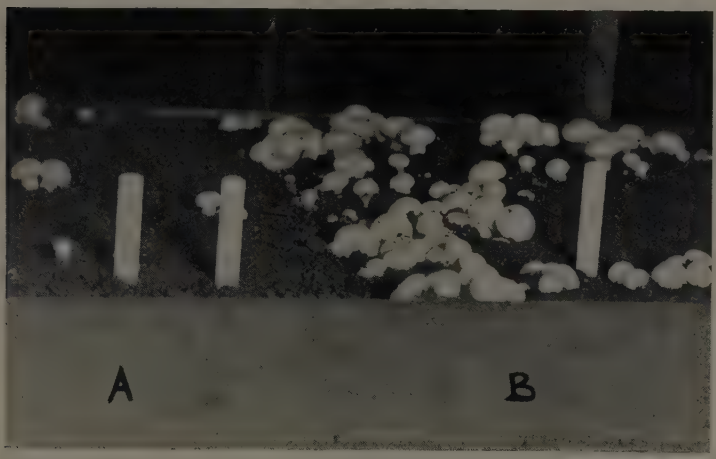


FIGURE 2.—Effect of texture of casing soil on the first break of mushrooms, Arlington Experiment Farm, 1934-35 : (*a*) sandy loam ; (*b*) Keyport clay loam.

In the opinion of the writers, the better yields obtained on the average with comparatively heavy soils than with lighter soils were due to the fact that a uniform moisture content was easier to maintain in the clay loams and clays than in sandy soil. The clays and clay loams listed in table 8 were surface soils well supplied with calcium and organic matter and were in exceptionally good physical condition. When a clay soil low in organic matter and in poor physical condition was used in a later experiment, however, the soil puddled and cracked on the beds and the yields were negligible.‡ It is evident, therefore, that although clays and clay loams seem to be capable of producing the best crops, there is considerable danger of a crop failure from the use of a heavy soil in poor physical condition. For instance, a clay loam subsoil devoid of organic matter and easily puddled when wet would be totally unsuited for use as casing soil ; whereas the surface soil of a field that has been in sod for a number of years and which therefore has a good structure and is well supplied with organic matter may be well suited for use as a casing soil even though it be of a heavier texture than the puddled clay loam mentioned above. Of course,

‡Data not shown in the tables.

if such a soil were acid, it would be necessary to neutralize it with ground limestone.

In practice most growers would be well advised to select loam soils of medium texture wherever possible and avoid the heavy clay loams. In exceptional cases in which the grower is thoroughly familiar with soil texture and the factors controlling physical conditions in soil, it may be advisable to attempt to increase yields by experimenting with soils of heavier texture.

Heat Sterilization of Soil : During the past 5 years several growers in eastern Pennsylvania have been steaming their casing soil to eradicate *Mycogone*. It is generally known that steaming certain soils may be detrimental to succeeding crops of higher plants. Therefore, preliminary experiments were carried out to learn something of the effect on yield of mushrooms of heating the casing soil at different temperatures. In the first experiment, Keyport clay loam was divided into five portions. One of these was placed in a layer 10 inches deep in an unused bed at the top of the mushroom house and allowed to warm up during the " peak heat," which was about 130° F. The other portions of soil were placed in cotton sacks in a special heating chamber and raised to the temperatures 150°, 170°, 190°, and 212°. The plots cased with soils heated in the chamber yielded only half as much as those cased with soil heated in the mushroom house at 130°. Similar results were obtained in a subsequent experiment. In this experiment the soil heated in cotton sacks was damaged in certain cases even when the temperature did not exceed 135°.

These experiments leave little doubt that serious loss in yield may result from the heating of casing soil under certain conditions. This question is being investigated further. Meanwhile a more critical attitude should be assumed toward heat treatment of mushroom casing soil than has been the case in the past. In some cases heat treatment may be desirable and beneficial ; in others it is clearly harmful.

Summary : Comparative tests indicate that casing practice may have a considerable influence on mushroom yields.

The thickness of the soil was not an important factor. The customary 1-inch casing seemed preferable.

Two or three weeks after spawning seemed to be the best time for casing.

Soil approximately neutral in reaction gave better yields than very acid soil or excessively alkaline soil. Ground limestone was found to be more nearly foolproof and therefore preferable to hydrated lime for neutralizing casing soil.

In general, heavy soils yielded better than sandy soils. Clay loams or even clays seemed preferable whenever their physical condition was such that they did not puddle or cake on the bed.

With the soil tested there was a noticeable reduction in yield as a result of heat sterilization under certain conditions.

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Fred. C. Atkins visits .....

Belgium's Research Centre

A Centre for Research on Mushrooms has been established at the National Agricultural Institute at Gembloux in Belgium, under Professors A. Willam and A. Lecrenier.

During the International Conference on Mushroom Science at Peterborough in May, I was invited to visit Gembloux to discuss their programme of research. An opportunity presented itself sooner than I expected and, on 2nd June, I was collected from my Brussels hotel by Monsieur G. de Man, a prominent Belgian grower and spawn-maker, and one of the sponsors of mushroom research in Belgium.

Motoring at 100—120 kilometres per hour we soon arrived at Gembloux. Professor Willam and his assistant, M. Heinemann, were unfortunately absent, but I was privileged to meet Professor Lecrenier and to spend an hour with him talking over the Belgian project and being shown round the magnificently equipped Institute.

The work on mushroom problems will not suffer from an inadequate library or from lack of laboratory equipment ; indeed, the only facility missing was an experimental chamber, and this was in process of being constructed in a cellar at the expense of the mushroom growers in the country.

There has been a satisfactory division of financial liability. The Institute is providing the scientific staff and allowing them the use of the laboratories, equipment, chemicals, etc. The mushroom growers are providing the test room, paying the salary of the grower and supplying the growing materials (compost, spawn, etc.). They also hope to have a travelling adviser ; I expressed the opinion that, had we been able to engage a suitable person to move around the country giving advice where it was sought, the struggle for M.R.A. funds would not have proved nearly so formidable.

Prof. LECRENIER

We agreed that, whereas pure research was fundamentally important and should on no account be ignored, its interest for practical growers was strictly limited, and that if the co-operation of growers was to be retained there would have to be something more tangible and concrete for them to feed on. It is proposed to send advisory leaflets to the Belgian growers at frequent intervals to rivet their attention to the Gembloux venture, and to "document" what has already been published on all aspects of mushroom growing on a commercial scale.

Professor Lecrenier will be responsible for this documentation and he will also supervise the practical side of the research programme, with emphasis on the significance of humidity, temperature and environment generally.

One of Professor Willam's first endeavours will be to persuade mushroom mycelium to fruit in pure culture. This should prove extremely interesting and may be highly significant, for no one seems to know exactly what causes spawn to produce mushrooms. By altering a synthetic growing medium by the addition or subtraction of this or that, Professor Willam hopes that in time it will be possible to discover the causes of fructification.

At all events, I conveyed to Gembloux the congratulations and best wishes of the M.G.A., and in return Professor Lecrenier said our M.R.A. was held in very high esteem over there and he and his colleagues would be only too happy to keep in the closest touch with us in the onslaught on problems of mutual interest.

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Spent Mushroom Beds as Manure

Survey Shows Growers Anxious to Obtain " Waste " Organic

The possibility that growers, desperately looking round for material at a reasonable price on which to feed their organically-starved soils, may find the answer in spent mushroom bed material, has been suggested by Mr. P. K. L. Danks, of Whiteparish, Wilts.

In a letter to *The Fruit Grower*, he says :

" There are several hundred mushroom growers in the country producing thousands of tons of spent mushroom bed each year. Those who have other horticultural activities naturally use the spent bed themselves.

" Those who have no other such activities have the greatest difficulty in disposing of this material, which is muck in concentrated form. As a mushroom grower, I might be accused of bias if I extol its claims. But why don't you chase up this spent bed business and publish an unbiased report on it.

" What most mushroom growers prefer is a price for the stuff *in situ*, the purchaser emptying the beds and carting the stuff away. If, of course, this isn't suitable, the mushroom grower will empty and cart at a much higher price."

We have acted on Mr. Danks' suggestion and consulted a representative cross-section of growers throughout the country. With few exceptions, mushroom growers report a steady demand for this material, and most growers have expressed themselves very pleased with the results. Here is what they say :

Mr. E. D. Sparkes, of Messrs. A. G. Sparkes, Ltd., Smugglers Farm Ltd., nr. Littlehampton : " We have plenty to spare and it can either be delivered or collected by the grower. When plentiful we charge about 11s. to 15s. per cubic yard delivered, or 6s. to 8s. per cubic yard if collected, although these prices might be higher when the stuff is not so plentiful. We use a certain amount ourselves on chrysanthemums and lettuce, but not on ground likely to be used for casing soil because of the danger of spreading spore infection. It's wonderful for lightening soils and has an excellent humus-forming value."

Messrs. Thompsons, mushroom growers and market gardeners, near Chichester : " We find it ideal used with strawberries and as a general top dressing and with tomatoes and asparagus. Because it is dry we believe it should be well watered before being ploughed in. We have none to spare."

Messrs. Knight's Nurseries, near Chichester : " We have found it better than ordinary manure, easy for working, keeps the soil open, and improves humus content."

Mr. H. F. Hart, managing director of Lindfield Mushrooms Ltd., of Lindfield, Sussex, reports that growers " fight to get it." He has

about 100 tons a month to dispose of, and growers collect it, paying about 10s. a cubic yard. He is on a five-years contract to growers, who have all expressed themselves pleased with it.

MR. A. DEB. HOVELL, Church Farm Nurseries Ltd., Rustington : "We have been using it as a substitute for dung since 1928, and have found it excellent for general vegetable work, although with a tendency to be slightly acid, necessitating the addition of lime."

MR. A. P. MCINTYRE, of Lancing, grower of soft fruits and general market crops, has found it especially useful for mulching strawberries, as it keeps down the weeds and makes hoeing easy. He says categorically that "it's no good for peas or lettuce," and thinks he is being charged too much for it. He suggests 3s. to 4s. a cubic yard as a reasonable price.

MESSRS. W. FROMOW, near Chiswick, London : "We use it for potting with good results, and collect it ourselves, paying 10s. to 15s. a cubic yard.

MR. J. STEWARD-WOOD, mushroom grower, near Aylesbury : "We have plenty for sale and are charging £1 a cubic yard delivered. It is also used on our own farm."

MESSRS. C. J. RANDALL, The Nursery, Rockbeare, near Exeter : "Our cucumbers are grown entirely in our own spent mushroom material and are giving excellent results. We have none to spare."

MR. R. MEADE, mushroom grower, Compton Abdale, Gloucester : "Although there is a very big demand, we still have some to spare."

MR. P. C. MAJOR, Duston, Northampton : "We have not the slightest difficulty in disposing of it to growers."

MESSRS. C. I. SPINKS, Southwell, Notts. : "It is marvellous material — especially for opening up heavy soil and making the soil easy to work. In our glasshouses we mix it into the top soil for tomatoes and lettuce, and also use it on gladioli bulbs and, outdoors, for mulching raspberries."

MESSRS. C. KING, of Woking, who have a mushroom area of 25,000 square feet : "Not the slightest difficulty in disposing of all surplus material, which we sell to a contractor who delivers in this area."

MR. J. G. A. SELLERS, mushroom grower, Ilkley, Yorks. : "I sell all my material to a contractor for 25s. 6d. a load, who disposes of it to gardeners."

To sum up this brief survey, most mushroom growers tend to combine other horticultural activities with their mushroom growing and, therefore, do not always have a great deal of spent material to offer for sale. Those who have plenty to spare, with few exceptions, have no difficulty in getting rid of it, and growers generally appear anxious to obtain it. Most are satisfied, and sometimes quite enthusiastic about its merits.

Mushroom growers who find it difficult to dispose of their spent beds can take heart in the knowledge that their horticultural brethren want the goods. **Possibly the periodic issue of a list of mushroom growers having material for disposal, is another job for the M.G.A. to tackle. It might do both sides good.**

PUBLICITY FOR MUSHROOMS

We have been talking for years about the desirability of some publicity for mushrooms, but this year's cataclysmic collapse in prices compels us to do something more definite to stimulate public demand for our delectable produce. How else can we arrest the decline? And if prices keep falling, how much longer will it be worth our while to carry on growing. With returns on odd days of 1/- lb while average production costs show no tendency of falling below half-a-crown, something must be done.

We have all read of the splendid publicity given to watercress this year by the National Market Produce Show Society working with the Watercress Growers. Our Chairman last year, General Sir Oliver Leese, is our representative on the Show Society's Executive, and he tells us that the Chairman (Mr. E. H. Gardener) has assured him that mushrooms will receive their fair share in the Horticulture Stand at the Festival of Britain. At the suggestion of the General Secretary (Mr. H. R. Haynes) a different product will probably be "featured" each week, and the M.G.A. has agreed to provide fresh mushrooms daily during our week.

In 1951, too, the National Market Produce Show moves from Southampton to London, and the M.G.A. plans to have its own Stand there. We are hoping, also, to go on from that Show to the Ideal Homes Exhibition at Olympia. At this moment the M.G.A. Show Committee (comprising Mr. A. DeB. Hovell, Mr. F. L. Filmer and our Secretary) is discussing with Sir Oliver Leese the most suitable form our exhibit could take. The Watercress Growers, you remember, had a miniature bed with cress actually growing in the water, against a background of pictures in colour depicting various stages of watercress culture.

The last meeting of the M.G.A. Executive discussed these useful proposals and sanctioned the necessary expenditure. Other suggestions put forward by our Publicity Committee (Messrs. Fred. C. Atkins, J. E. R. Simons and Stanley Middlebrook) included the following:

Encourage Grading. The lower prices fall, the more "choosey" will be the buyer, and the mushrooms which are properly graded will fetch the best prices. The Ministry of Agriculture is officially recommending the adoption by mushroom growers of the M.G.A. Grading Committee's proposals not *en bloc* perhaps, but substantially on the same lines (see p. 240).

Conduct research into pre-packaging. By "pre-packaging" is meant packing in such a way that the goods themselves are not handled after leaving the farm until they reach the consumer's kitchen—which probably means packing our mushrooms in ½ lb or ¼ lb cartons.

Find a "slogan." We want something snappy which is related to the truth as well as to cultivated mushrooms, and should, if possible, stress the value of mushrooms in the nation's diet. It could be used on every mushroom pack and might figure on attractive showcards to be distributed to each retailer. It might also be displayed prominently on all mushroom farms in the country.

Make a film. The idea is to approach a film producer with the suggestion that a short " documentary" be made of the romance of the Mushroom Industry—from Louis the Fourteenth's first ridge beds at Versailles to to-day's complex thermostatically-controlled practice.

Publish recipes. We are wondering whether the women's journals could be persuaded to run competitions for the best mushroom recipes. A selection of these winning recipes might be made into an attractive booklet and distributed from our Stand at the Ideal Homes Exhibition, or through the retailers. Some might be printed on the pre-package cartons we are considering.

This publicity campaign will in fact be launched on October 4th when Mr. André Simon, president of the Wine and Food Society, will be speaking at our fifth annual luncheon.

The French growers were faced in 1938 with the same predicament as ours to-day—low prices and not enough money in the kitty to pay for expensive advertising. Monsieur Dekeirel, their Secretary, tells us they set up a Publicity Committee under their present President, Monsieur Guiochon, and articles were published three times a month in two Paris newspapers and in two women's magazines inviting the public to write for a booklet of recipes giving new ways to prepare mushrooms. The same invitation was printed on the paper bags used for the packing of mushrooms. During the first three months of the campaign 5,484 people wrote for the recipes.

At the same time, with the help of the Ministry of Agriculture, a " mushroom communiqué " was broadcast once a month from two stations, and it was becoming apparent that the consumption of mushrooms was rising when the War stopped everything.

Fred. C. Atkins Thinking It Over .....

THE WAY AHEAD

When I went to speak at the Preston Glasshouse Conference in February, the *Manchester Guardian* reported that I depicted the commercial mushroom grower's prospects in " discouraging terms."

I need not add that, had I been speaking six months later, those terms would have been even more discouraging, but I mention the report because the M.G.A. *is* sometimes accused of painting a too sombre picture merely to dissuade newcomers from entering into competition with established growers.

It cannot be denied that prices at the end of the war and for two or three years afterwards made our crop irresistibly attractive to many, especially demobilised Servicemen, with the result that production to-day is about twice what it was just before the war. Yet few of us were prepared for the catastrophic fall in prices which naturally ensued when supply was doubled and nothing had been done to stimulate demand. The lack of alternative foods kept our price from falling too steeply, but the increasing " tightness " of money and the arrival this year of many delicacies in pre-war profusion have led us to the predicament facing us to-day. I trust that all those prospective growers whom we advised to base their calculations on 2/6d. lb. gross did so. Some who ignored our warnings are now regretting it.

Can we all grow at 2/6d. lb. gross, and make a living? Some of us think it scarcely worth our while to try, and indeed there are so many problems and risks always around us that unless we can reduce our costs of production our profit is likely to be negligible.

I suggested to the Preston Conference that the solution lay in increased output and a pooling of knowledge. By increased output I meant more mushrooms from a given area, i.e., greater efficiency; and we can achieve greater efficiency only by pooling our present knowledge and gaining fresh knowledge from practical and scientific research.

We must do what we can to encourage growers to tell us through the Bulletin of their **experiences.** The original Mutual Aid Section of the Bulletin failed because growers as a whole decided it was more blessed to receive information than to give it. Indeed, one grower modestly confessed he knew all the answers and gave it as his preposterous reason for not renewing M.G.A. membership. As if any mushroom grower had no more to learn . . . .

We must make greater efforts to get together—not just at Annual Meetings and at the Research Station's Open Days; those two days a year are too fully occupied with other matters to allow us to talk leisurely. I trust our new Chairman will be able to carry through his plans for a series of **Area Meetings** at which groups of growers can talk together at greater length than is possible on more formal occasions.

We must try to co-ordinate the loose threads of practical **experimentation,** which goes on incessantly. I have visited a great many mushroom farms; on none do I recall hearing that nothing of interest was being tested, no experiment being tried. Just imagine the stimulation which would follow a frank discussion of what was going on "behind the scenes" at only half-a-dozen mushroom farms!

More important than anything else at the moment, we must keep the Yaxley **Research** Station in being. As Dr. Johnson suggested, when a man knows he is to be hanged in a fortnight, it may concentrate his mind wonderfully; but a feeling of insecurity is scarcely the most desirable atmosphere for scientific research. As I write this note we have not sufficient funds in hand to pay the Staff's October wages, and one question obsesses and oppresses us: *Are we going to pay for mushroom research—or shall we abandon it?* Those of you who know me personally will realise how bitterly I pen that question. It is stated in Proverbs that "he that repeateth a matter separateth many friends"—but so many have already written to tell me they will subscribe "the same as last year" that I feel confident there will be enough "friends" to see us through. We must talk it over on October 4th.

Macmillan & Co., of New York, are publishing Mr. Atkins' book, *Mushroom Growing To-day*, in the United States. Copies are still available to Members through the Secretary at 12/6.

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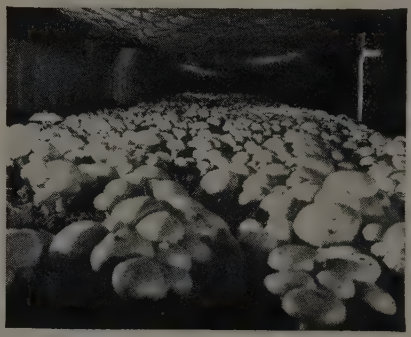

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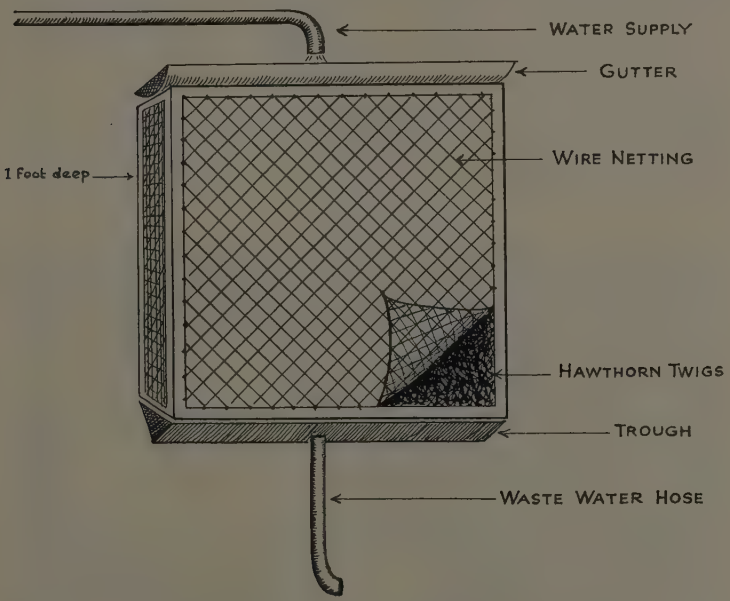
SIMPLE COOLER FOR MUSHROOM HOUSES

By J. A. STOCKWELL

During visits this summer to mushroom farms round the countryside on behalf of my firm, D. C. Bushell & Co. Ltd., I noticed marked signs of apprehension amongst some growers at the spectre of hot days and nights, and the drastic results to crops from same, not to mention market returns, etc. With this in mind, I offer the following idea for a simple cooling plant in the hope it will smooth out some of the growers' problems.

The principle consists of filtering warm exterior air through dripping water, and this is achieved by making a frame to fit over an end window or ventilator of the mushroom house. The frame is covered with wire netting, gauge not being important. Into this pack hawthorn twigs, to be found in abundance along most hedgerows. It is advisable to allow the sap to dry out before using. On top of the frame screw (or nail) a " gutter " of galvanised sheet or tin, along the centre of which



drill (or tap) small holes at inch intervals approximately. The ends of the gutter can be blocked with wood cut to shape. To the bottom of the frame screw (or nail) a wooden trough with a length of hose (the piece you nearly threw away !) inserted into the centre for the waste water to escape.

The water supply into the gutter can be from an overhead tank or main, the quantity used being quite small, as only a trickle is necessary to achieve the desired result. If a still lower temperature is required, an extractor fan fitted at the opposite end of the mushroom house will increase the flow of cooled air, but should not be necessary if the cooler is fitted to the " prevailing " end of the house.

The advantage of this type of cooler is threefold : cheapness (most important), simplicity, and finally a cool moist atmosphere produced.

CULTIVATING MORELS

Mrs. Matthew Pinkerton discussed the cultivation of Morels in M.G.A. Bulletin 17. For the benefit of those who wish to study its possibilities further, we reproduce with Dr. E. B. Lambert's permission this note from his paper, entitled : " Principles and Problems of Mushroom Culture," which appeared in the Botanical Review, No. 4, pages 397-426 ; July, 1938.

Several investigators have attempted to grow morels with varying degrees of success (1). The spores are easy to collect and germinate overnight (2, 3). The mycelium grows vigorously in many autoclaved media, inulin appearing to be a preferred form of carbohydrate (4). Sclerotia are frequently formed, but no one has attained more than sporadic success in the production of fruiting bodies. The literature along this line has been recently summarised by Heim (5) and Costantin (6, 7, 8). Since closely-related fungi are fertilized with conidia not unlike the morel conidia (9), it would seem probable that a fertilization phenomenon is one of the requisite factors for morel fructification.

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CLITOCYBE DEALBATA as an Invader of Mushroom Beds

By

W. BUDDIN and W. M. WARE

In February of the present year, a mushroom grower, near Petersfield, Hampshire, drew the attention of one of us to the occurrence of a white toadstool on the casing of both indoor and outdoor mushroom beds, where it was forming large groups or masses of fructifications, and at the same time was filling the compost and the casing soil with a coarse white mycelium. The beds had been spawned for over three months and should have been bearing mushrooms, but it was evident that the mycelium was crowded out by the unwelcome visitor, and that no crop could be expected in the face of such severe competition.

Miss Wakefield, of the Herbarium, Royal Botanic Gardens, Kew, very kindly indentified the fungus as Clitocybe dealbata.

So long ago as 1861, the father of British mycology, the Rev. M. J. Berkeley, described and figured in this journal (6th April, 1861, p. 312) a form of Agaricus dealbatus (=Clitocybe dealbata) as an invader of a mushroom bed; from the further accounts (*Ibid.*, pp. 337 and 460), the bed was situated, with others not attacked, in a cellar at Highgate, in which the air temperature was between 40° and 55° F.

FIG. 1.—CLITOCYBE DEALBATA

Interior view of Mushroom house, showing large groups of the fungus on ridge-beds on the floor. Above these there is a shelf which was not invaded, and where a good crop of Mushrooms was produced.

The gardener reported that the bed (twelve feet by seven feet) had borne an excellent crop for three months previously, but that Clitocybe dealbata had suddenly appeared in several places simultaneously on the bed. As showing that conditions were correct for mushroom growth, he mentions that one of the adjoining unaffected beds had produced 160 lbs. of mushrooms between 7th October, 1860, and 22nd February, 1861. No heat and no straw covering had been used for any of the beds.

In France, in 1892, Costantin (1) described a "disease" of mushroom spawn and beds which he called "Le Chanci" and which he attributed to Clitocybe candicans. He mentions that the mycelium develops in the straw covering of the beds and, though chiefly near the surface, it penetrates deeply into the compost. It resembles, he states, the mushroom mycelium, but can be distinguished by a strong, acrid, disagreeable, penetrating smell. Costantin records that "Le Chanci" develops more rapidly in beds exposed to plenty of fresh air and to a low temperature. He and many mushroom growers had been under the impression that the fungus existed only in the mycelial state, but eventually he was able to produce in the laboratory small sporophores with caps only 3 mm. wide and 2 mm. high, and with stems 2 mm. long. One larger specimen with cap 3 cm. in diameter and stem 3 cm. long, was submitted for identification to M. Boudier who though it to be Clitocybe candicans, but Costantin himself expresses uncertainty, and suggests that it might have been C. dealbata. The identification (2) was therefore in doubt. Costantin quotes a published account by Roumeguère of Clitocybe sp. growing on mushroom beds at Clermont-Ferrand, and also quotes a M. Michel, of Carrière-sous-Bois, as having often observed C. dealbata growing on old mushroom bed manure. The grower on whose premises M. Michel had seen this, gave the information that "Le Chanci" frequently developed in his rather cold mushroom quarry. Costantin was evidently of the opinion that the fungus was introduced with the spawn, for where the Clitocybe appears in quantity, he states, the grower has been imposed upon.

Two years later, in 1894, Costantin and Matruchot (3) state that "Le Chanci" is not very common and, according to their information at that time, it is again asserted that the trouble develops more readily in cold beds. They couple the name of Pleurotus mutilus with that of Clitocybe candicans as the cause and state that neither of these produces sporophores at all frequently on the surface of the bed; to diagnose "Le Chanci" therefore, the advice is given to pull out the compost and judge by the smell of the mycelium.

Since these earlier records, Worthington G. Smith (4), Massee (5) and Swanton (6) have all included in their general books a statement to the effect that a form of C. dealbata frequently occurs in old mushroom beds.

In more recent years, it would appear from our own experience and from correspondence with other centres, that the occurrence of the toadstool on mushroom beds is rarely reported by growers, although Mr. J. Ramsbottom, Keeper of the Department of Botany at the British Museum (Natural History), has kindly given us the information that the present species has been sent to him on half-a-dozen occasions since the war.

The case in Hampshire now being considered seems to be exceptional, both in the earliness of the appearance of the Clitocybe on the beds, and in the completeness of the invasion. The introduction of the toadstool took place apparently in September, 1930, when a truckload of dung was used to complete the ends of the beds, including a shelf-bed in one house, and to make up further beds in a house some fifty yards distant. From March, 1931, onwards, the parts of the beds in the first house which had been made up from previously received manure, gave rise to a good crop of mushrooms, but on those parts which had been made from the one additional truck of manure, Clitocybe appeared along with the mushrooms. In the second house, where by chance the mushroom crop was not so good, a similarly limited appearance of Clitocybe occurred. Both these houses were unheated and have since gone out of use. The infection was carried in some way to a third house which was heated, to a fourth not heated, and to adjacent outdoor beds, for in the following year, in the early spring of 1932, a large growth of the toadstool came with the second " flush " of mushrooms, and altogether prevented the growth of the third " flush." Large clumps of the fungus were removed and buried in a deep pit, and it was estimated that for each punnet of mushrooms picked, five bushels of the toadstool were removed. In June, 1932, the contest was given up.

In January, 1933, on new beds on the floor of the third house and on a new outdoor bed adjoining, the Clitocybe began to fructify. Although, owing to circumstances, the heat was discontinued, by early February the Clitocybe was occurring throughout the beds, both ridge and flat (Fig. 1) in the house and under the straw covering of the outdoor bed. The grower was probably right in anticipating that he would pick not a single mushroom from all the beds on the floor of the house,

FIG. 2.—CLITOCYBE DEALBATA

A comparatively small group of sporophores, showing the crowded condition and the wavy, upturned margins of the caps. The coarse white mycelium that " runs " through the casing soil is seen below; about half natural size.

FIG. 3.—CLITOCYBE DEALBATA
A few sporophores of the fungus, showing the upturned edges and the formation of secondary, cup-like pilei with gills. Approx. nat. size.

for even in places where no clumps of the toadstool were present, the somewhat coarse white mycelium was permeating both casing soil and compost. It is important to note here that a large shelf-bed, occupying the central part of the house and laid on corrugated iron supported on wooden poles, had already been cropping well and was entirely free from invasion by Clitocybe. Underneath it (Fig. 1) and on all sides, the floor beds were bearing large clumps of the white sporophores, a fact which gave rise to the idea that the Clitocybe had probably penetrated the floor beds from the soil and had been unable to enter the shelf-bed. In the fourth house, in February, 1933, comparatively few of the toadstools had appeared. The beds in this house had been prepared some weeks before those in the heated house and anxiety from the non-appearance of mushrooms led to further investigation; it was found that the whole of the manure was permeated by the characteristic mycelium of the Clitocybe.

To every mushroom grower the matters of concern are, firstly, the cure and, secondly, the origin of any disease or trouble with the beds; the present case is of peculiar interest, therefore, because it assists in removing from suspicion some of the possible sources of contamination and indicates that infection must have come originally with the manure. Before the present almost universal employment of pure-culture spawn, there may have been good reason to suspect the spawn, and Costantin describes experiments which he carried out, using spawn known to have been affected with "Le Chanci." In the present instance, however, pure culture spawn was planted and, from our knowledge of the processes of preparation, it is most unlikely that the spawn could have contained mycelium of the toadstool. From the fact that in the very first year of its occurrence the Clitocybe appeared on a shelf-bed as well as on beds on the ground, it is apparent that the earth floor of the house was not the original source. Like the case described by Berkeley, no litter was used, except on the outdoor bed, so the straw covering cannot be blamed. The casing soil, derived from one source

and dug from the subsoil, is exempted, because in the first year of the trouble, the fungus appeared only on parts of the beds and was not generally scattered. Its very localised occurrence in 1930-1, only on those ends of the beds made with one particular truck of manure, points to the manure as the means of introduction.

The manner in which the fungus has established itself in quantity on the premises and spread from house to house and to an outdoor bed near by, is a matter both of speculation and concern. Apart from distribution by spores, the spread can be explained on the supposition that fragments of the compost, white with the mycelium of the Clitocybe, may easily have been carried on the boots when an infected house was being cleared out. On these particular premises, after removal of the beds, no method of disinfecting the floor was practised, and it is probable that the mycelium of the Clitocybe, which is very vigorous, could readily have penetrated the beds in a downward direction and have become established in the earth of the floor. It is well known that mushroom mycelium is capable of doing this and can persist in a dry earth floor even for years. The farmer in the present instance had been growing mushrooms previously to 1930 and had never met with any Clitocybe, a fact which supports the idea that the fungus was introduced to his premises from some outside source.

Measures of control advocated were to take out completely the infected beds and to dispose of them as part-used manure for land far removed from the present site. The interior of the shed was lined with straw which extended down the walls to the floor ; it was suggested that this should be removed, if not entirely then certainly the lowest three feet or so, nearest the ground. Internal thatching is not to be recommended for mushroom houses on account of the shelter it affords to both animal and fungus pests ; a smooth matchboard lining is preferable as being cleaner and because it renders more effective any spraying or fumigating which it may be necessary to give.

It was further recommended that after cleaning out and spraying the whole house with two per cent. formalin solution, the earth of the floor should be well forked up and treated with the same strength of formalin solution, using at least half-a-gallon to the square foot. In order to diminish the risk of such costly failures and to cheapen and facilitate the desirable routine disinfection of mushroom houses between seasons, the use of concrete floors in permanent houses is obviously an advantage.

Here it would be well to mention that measures such as those described are wasted if every care is not taken to avoid further contamination from other uncleaned houses or beds. Thus, tools, barrows and carts, as well as the boots of workers, should be cleansed before passing from use in an infected house to one which has been sterilised.

As being of interest to mycologists, a few details concerning the Clitocybe dealbata occurring in Hampshire are given. The habit of the fungus, as can be seen from the illustrations (Figs. 1 and 2) was densely caespitose. Fresh specimens and freshly exposed mycelium in the beds had the smell known to mycologists as that of new meal, although it was somewhat acrid and penetrating. The colour of the fungus led to some hesitation in naming it as C. dealbata for, according

to Carleton Rea (7), this species is whitish, with greyish or flesh-coloured zones towards the margin, whereas the present specimens were in all cases definitely white. This difference may be due to the abundant nourishment or to the darkness of the habitat ; it may also explain why former writers, including the Rev. Berkeley, refer to a " form of " Clitocybe dealbata. This fungus grows usually in meadows and by road sides and railway banks, and all descriptions emphasise its caespitose habit. Clitocybe candicans, on the other hand, was originally recorded as growing among leaves in woods. This is confirmed by Lange (8), who states further that C. candicans is never fasciculate.

The white masses or groups of crowded sporophores measured one-and-a-half foot to three feet in diameter. The upper surface of the cap, which was not umbilicate, was white and with satin lustre ; the gills (up to 7 mm. in width and not linear) were also white, but with age they took on a very pale fawn or biscuit colour. The caps of mature specimens

FIG. 4.—CLITOCYBE DEALBATA
Stages of development as they occurred on the Mushroom beds. Those at the top (left) are the youngest shown in the illustration, but smaller ones were plentiful ; two-thirds nat. size.

were not flat, but were turned upwards, with wavy irregular margins (Figs. 1, 2, 3). The gills consequently at first sight appeared to be decurrent, but on cutting through the sporophore they were found to be adnate and scarcely decurrent. The stems were white, of silky lustre when dry, or nearly woolly when growing in the centre of a dense clump. They were smooth or sometimes with faint longitudinal corrugations ; those grown indoors were solid, while those from the outdoor bed were becoming more or less hollow. Young specimens, only 5 mm. high and similar to those figured by Costantin (*loc. cit.*) were plentiful on the casing and all stages of growth were present (Fig. 4). The largest mature pilei measured 9.4 cm. in diameter, and it may be noted that on the upper surface of some of these there occurred wart-like protuberances which opened in the form of a cup (Fig. 3) up to 2½ cm. in diameter and containing the gills ; on others there occurred more perfect secondary pilei which were not inverted. This phenomenon, it may be mentioned, was described and figured by Berkeley in 1861.

It is evident that although Clitocybe dealbata is only of occasional occurrence in this country on mushroom beds, it is nevertheless to be regarded as a serious pest or competitor of the cultivated mushroom, and in this respect may be classed with the Plaster Mould, Oospora fimicola, and the mushroom bed Sclerotium, Xylaria vaporaria, both of which have occasionally come to our notice as serious pests.

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PRESS CUTTINGS

Horticulture reaches the middle of the century at a time of great political uncertainty . . . . Of the more specialised crops like asparagus, sea-kale, forced rhubarb and **mushrooms,** the only salvation will be in quality, coupled with the realisation that the day of high prices has gone. At the same time, none of these crops can stand any spectacular increase in area unless it can be accompanied by a very substantial drop in the cost of production and, consequently, the selling level.

Contributor to The Grower, 7.1.50

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K. A. Lord, of Rothamsted, in the Annals of Applied Biology, March, 1950

Lord Carrington, in proposing solutions to the import problem (in the House of Lords), followed very closely the line taken by N.F.U. spokesmen recently in advocating the revision of specific **tariff** duties so that their incidence should be the same as it was in 1938.

Nurseryman & Seedsman, 20.7.50

Who is London's largest farmer? He is 66 year-old South African, Mr. Albert Rose, who farms 140 acres in Hounslow . . . . . A speciality of the farm is **mushrooms,** 300 lb being produced in a day.

Evening Standard, 15.7.50

The recently-launched Socialist scheme for Horticultural **Marketing** was condemned as dishonest, and thrown out as impracticable and woolly thinking, at a gathering of the N.F.U., the National Federation of Fruit and Potato Trades, the Retail Fruit Trades Federation and the Trade Press on Thursday last week. *Fruit Grower*, 10.8.50

Mr. R. T. Pearl, Head of the Horticultural Department at the University of Nottingham School of Agriculture, Sutton Bonington, is leaving to become Head of the Ministry Publications Department, in place of Mr. A. H. Hoare who retires. *Grower*, 5.8.50

General Sir Oliver Leese, famous soldier turned horticulturist, proposing the toast of "The Show Society"—he was principal guest at the Market Produce Show's Luncheon at Southampton—spoke of its rapidly increasing membership, and emphasised that it was vital for every grower and for everyone connected with the Industry to become a member. *British Farmer*, 31.7.50

(*Sir Oliver represents the M.G.A. on the Produce Show Committee —Editor*)

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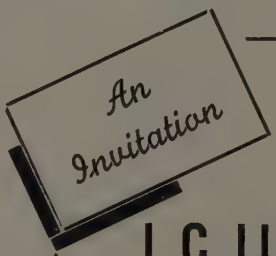

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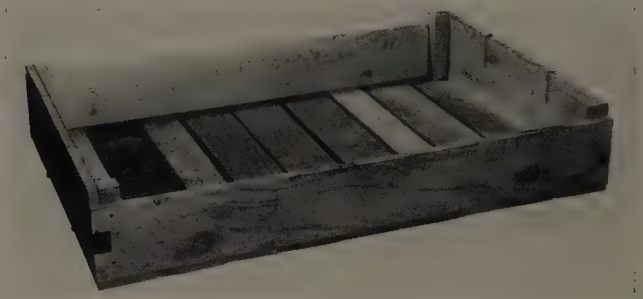

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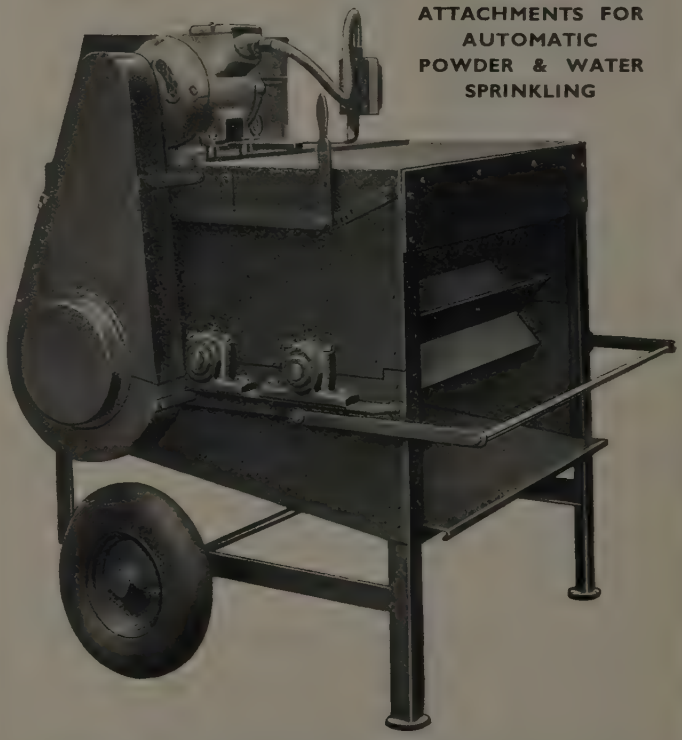

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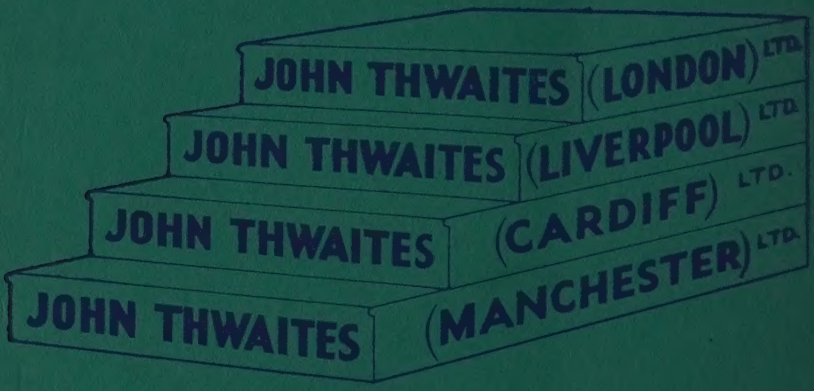

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